Soybean Stem Diseases

Sam Markell
Professor and Extension Plant Pathologist

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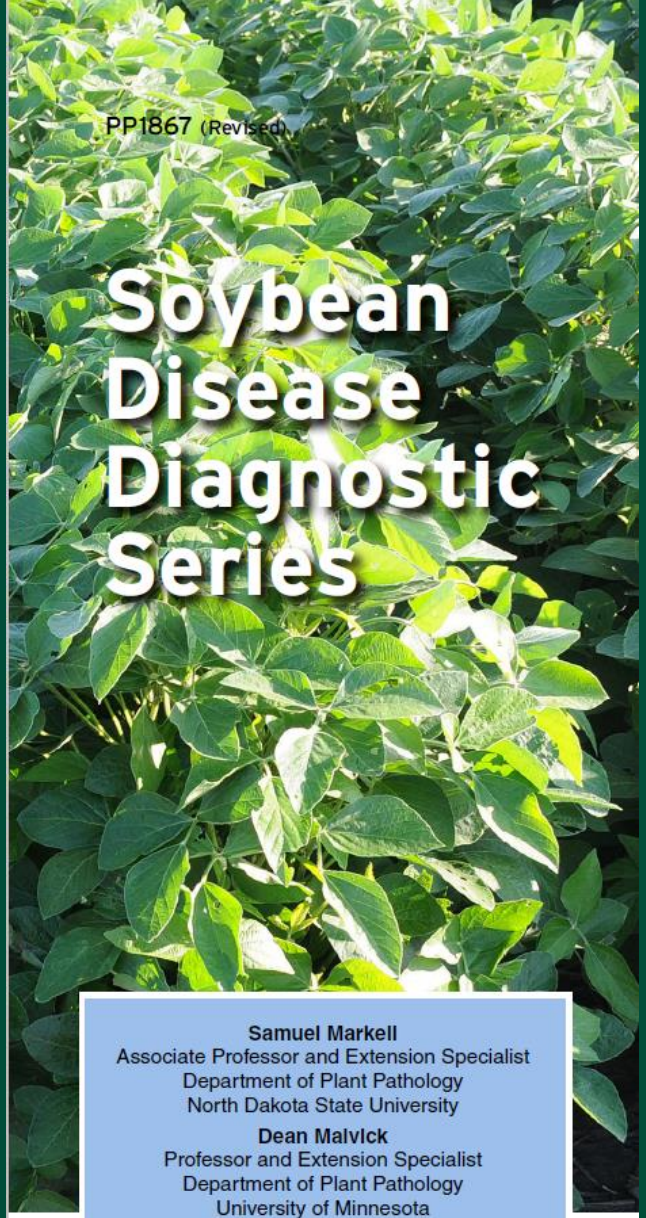

PP1867 (Revised)

Soybean Disease Diagnostic Series

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Minnesota Soybean Research & Promotion Council

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Root Diseases

Stem Diseases

Leaf Diseases

Additional Diseases (not known to occur in ND/MN)

Cover photo: Sam Markell, NDSU

For more information on this and other topics, see www.ag.ndsu.edu

Top 10 most destructive soybean diseases in the Northern US (2010-2014)

TABLE 4
Ten most destructive diseases and associated estimated soybean yield losses (bushels in thousands) by disease or type of disease in the northern United States[w] and Ontario, Canada, from 2010 to 2014

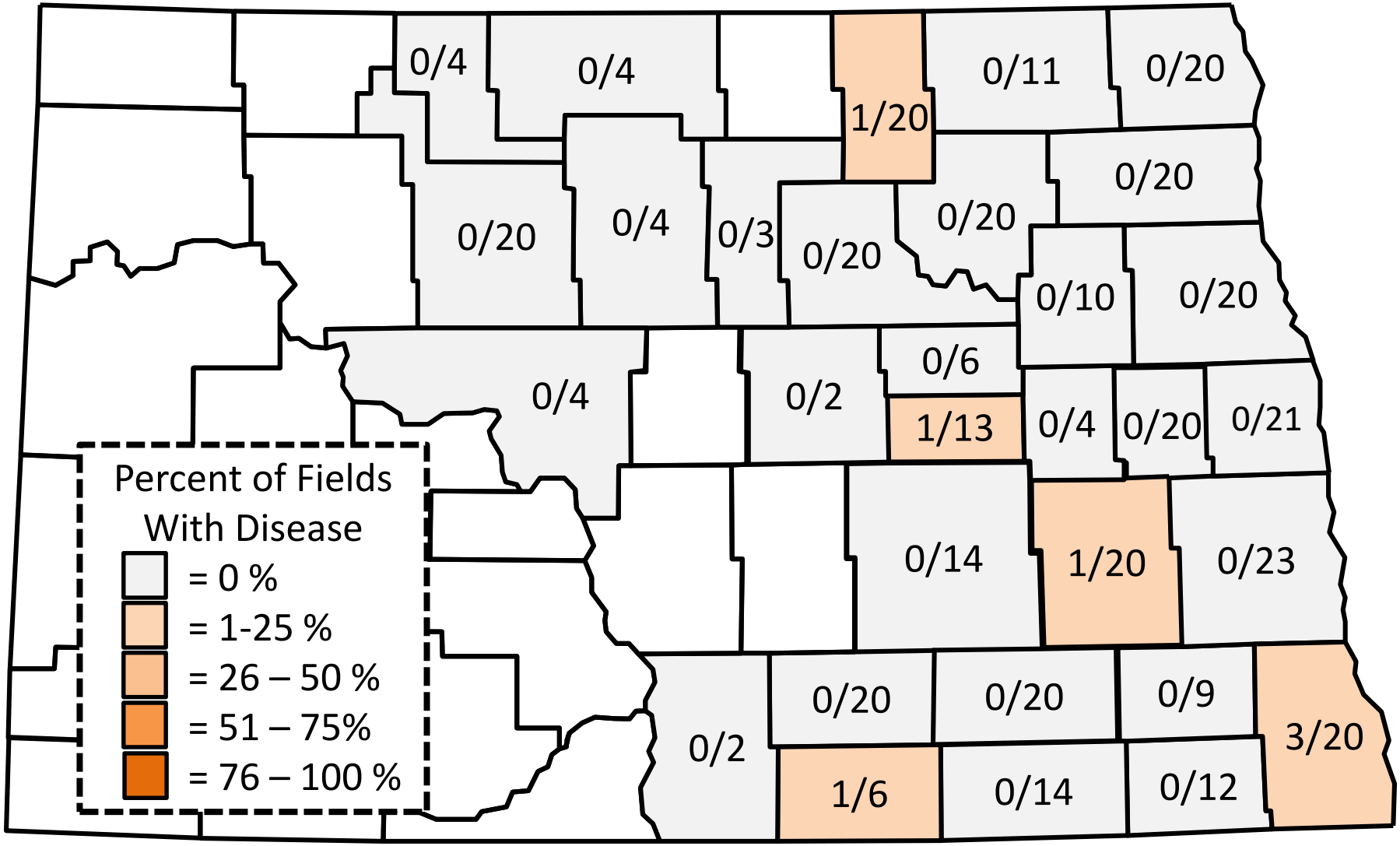
	2010		2011		2012		2013		2014	
Rank	Disease	Loss	Disease	Loss	Disease	Loss	Disease	Loss	Disease	Loss
1	SCN	110,325	SCN	90,525	SCN	118,697	SCN	112,394	SCN	108,008
2	SDS	70,658	Seedling diseases	46,847	Char Rot	59,481	Seedling diseases	43,672	Seedling diseases	60,305
3	Seedling diseases[x]	55,000	Phytophthora root and stem rot	33,180	Phytophthora root and stem rot	23,950	Char Rot	31,865	SDS	46,815
4	Phytophthora root and stem rot	35,967	Char Rot	29,403	Seedling diseases	23,642	Phytophthora root and stem rot	29,134	White M.	40,709
5	Char Rot	25,935	SDS	22,835	SDS	21,831	SDS	20,391	Phytophthora root and stem rot	32,864
6	Septoria brown spot	25,306	Septoria brown spot	17,954	Fusarium wilt and root rot	14,636	Septoria brown spot	20,209	Septoria brown spot	24,030
7	White M.	24,520	Fusarium wilt and	16,492	BSR	12,532	White M	17,663	Char Rot	18,347
8	BSR	13,465	BSR	14,064	Viruses[y]	11,661	BSR	10,385	BSR	13,686
9	Fusarium wilt and root rot	10,689	White M.	12,770	Septoria brown spot	6,379	Viruses	7,543	Stem Can.	11,871
10	Pod&Stm	9,514	Pod&Stm	8,404	White M.	5,530	Stem Can.	6,052	Pod&Stm	10,540

[w] Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Nebraska, North Dakota, Ohio, Pennsylvania, South Dakota, and Wisconsin.
[x] Seedling diseases include those caused by *Rhizoctonia*, *Pythium*, *Fusarium*, and/or *Phomopsis* spp.
[y] Includes *Bean pod mottle virus*, *Soybean dwarf virus*, *Soybean mosaic virus*, and *Soybean vein necrosis virus*.
[z] Includes *Bean pod mottle virus*, *Soybean dwarf virus*, *Soybean mosaic virus*, *Soybean vein necrosis virus*, *Tobacco ringspot virus*, and *Tobacco streak virus*.

Allen et al. 2017. Plant Health Progress 18:19-27

Soybean Stem Disease Survey

- North Dakota Soybean Council supported
- 2017 and 2018
- 400 fields
- Stem diseases only



Phytophthora Stem/Root Rot

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www.ndsoybean.org

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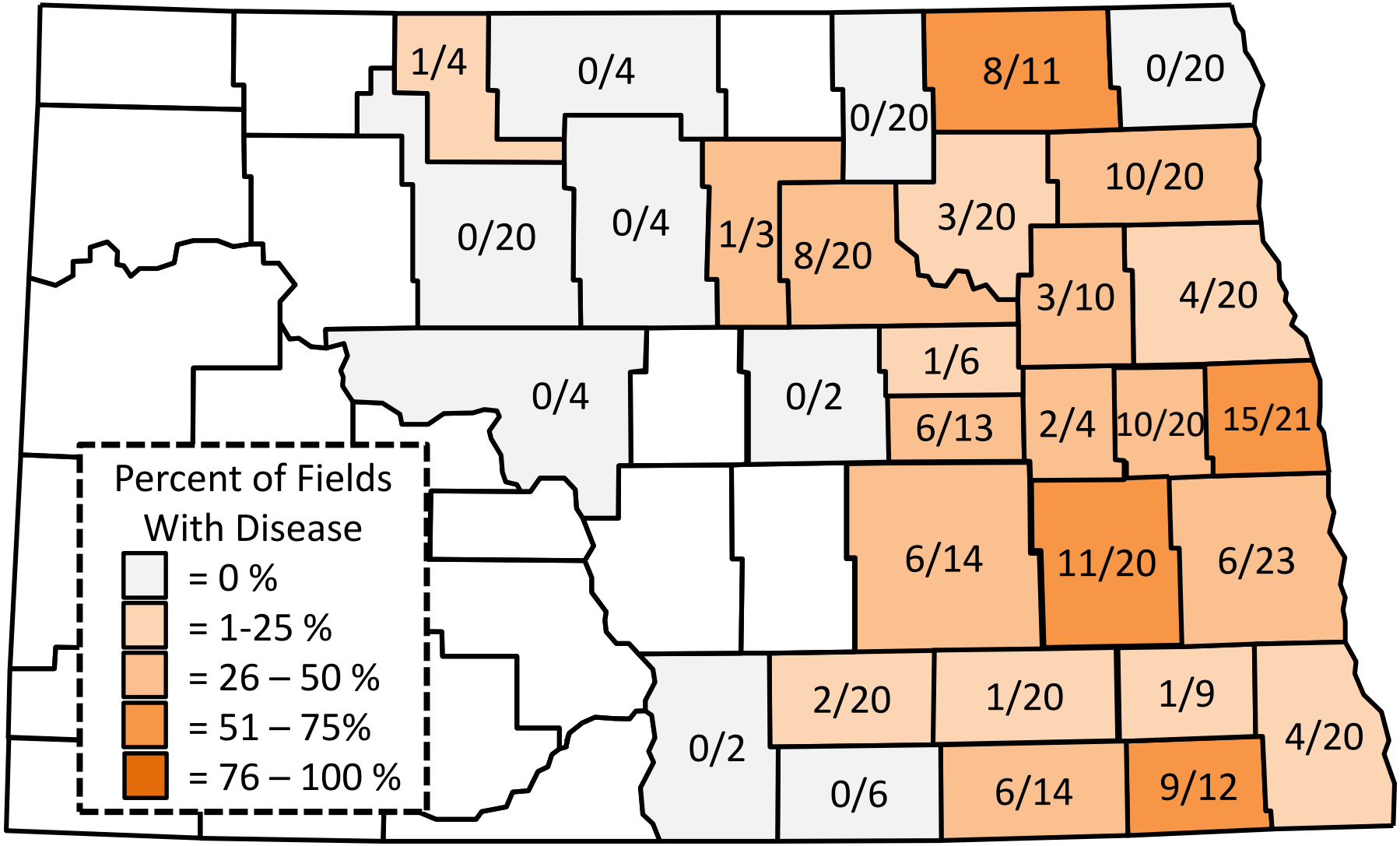

Anthracnose

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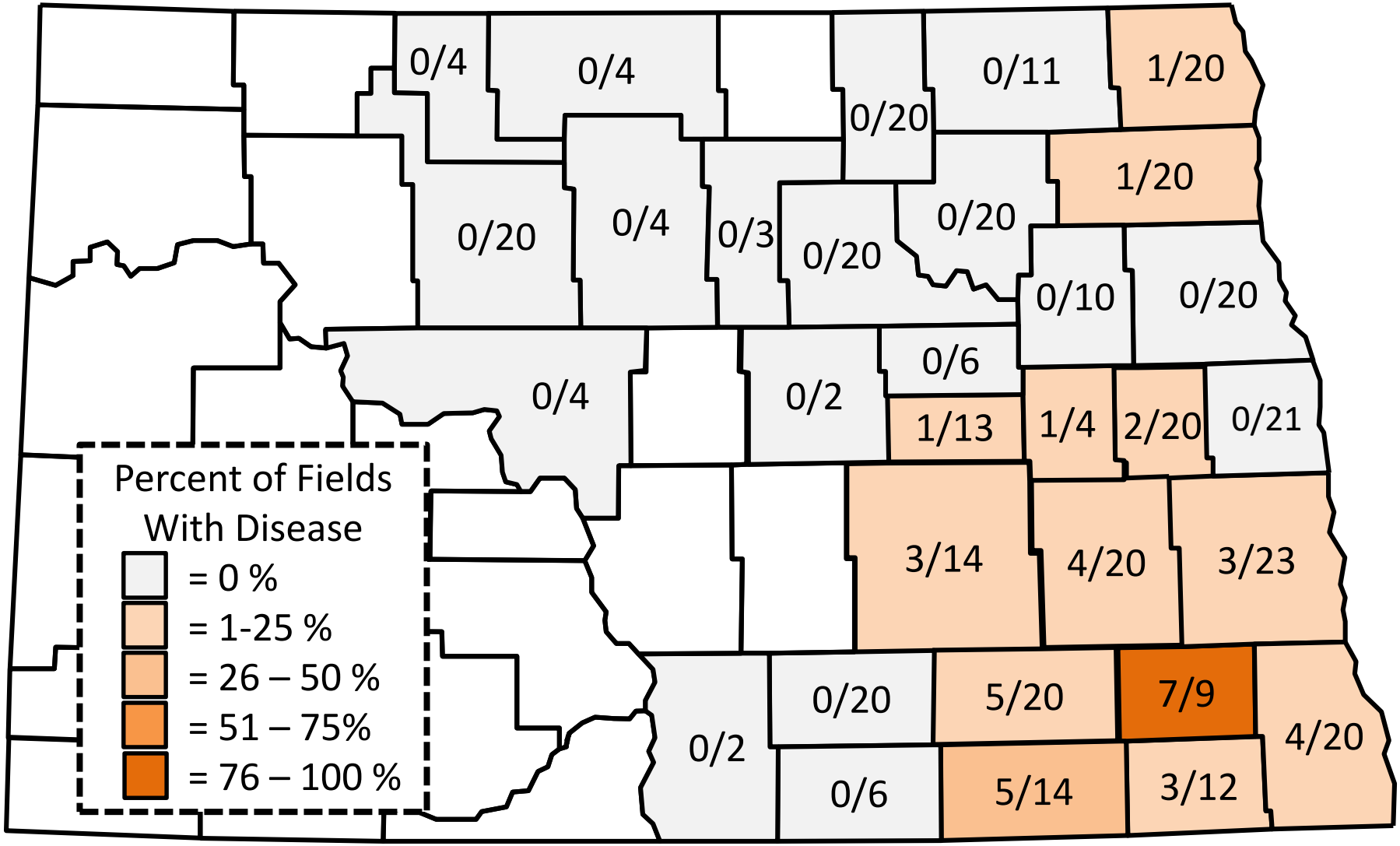

White mold

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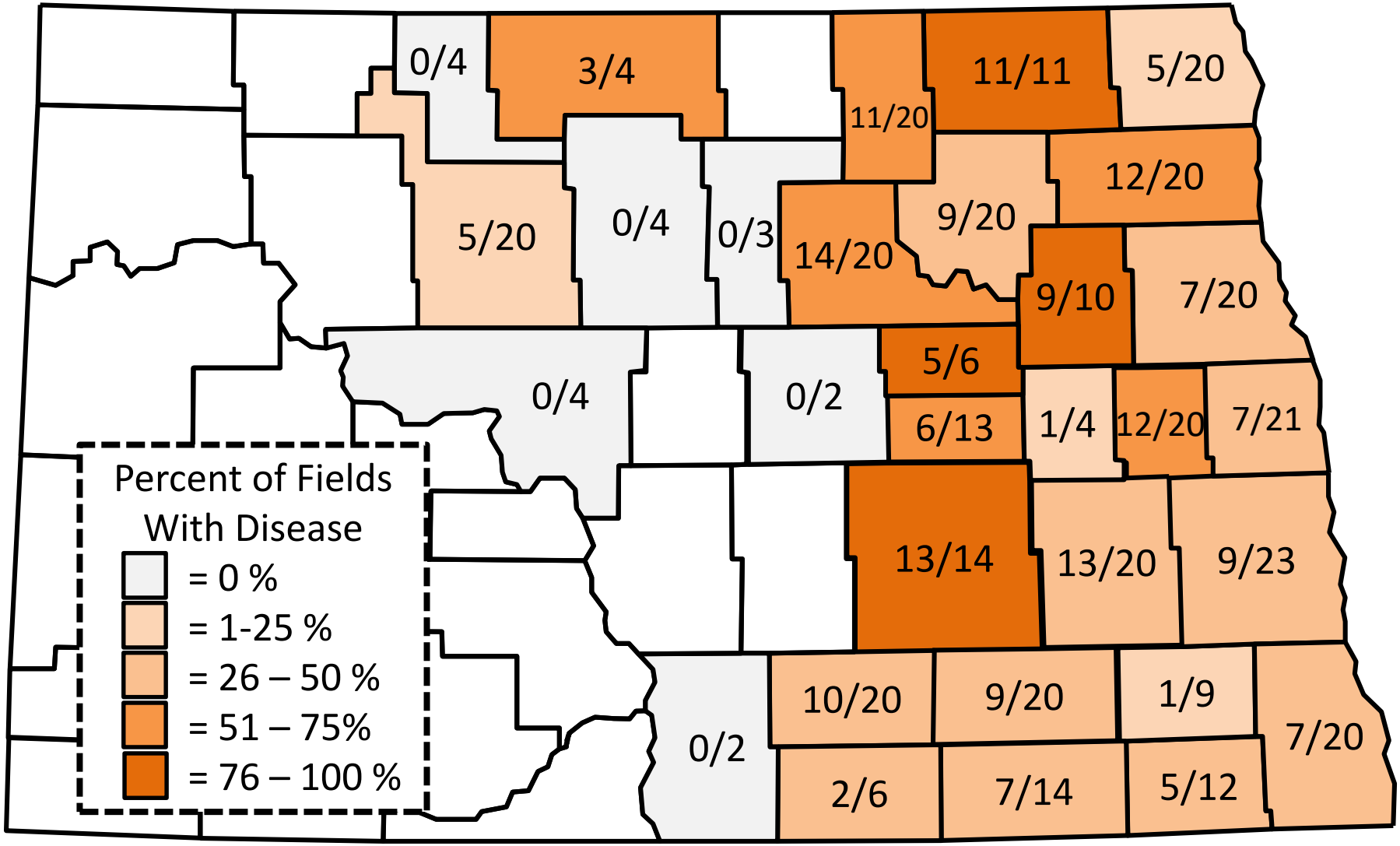

Northern Stem Canker

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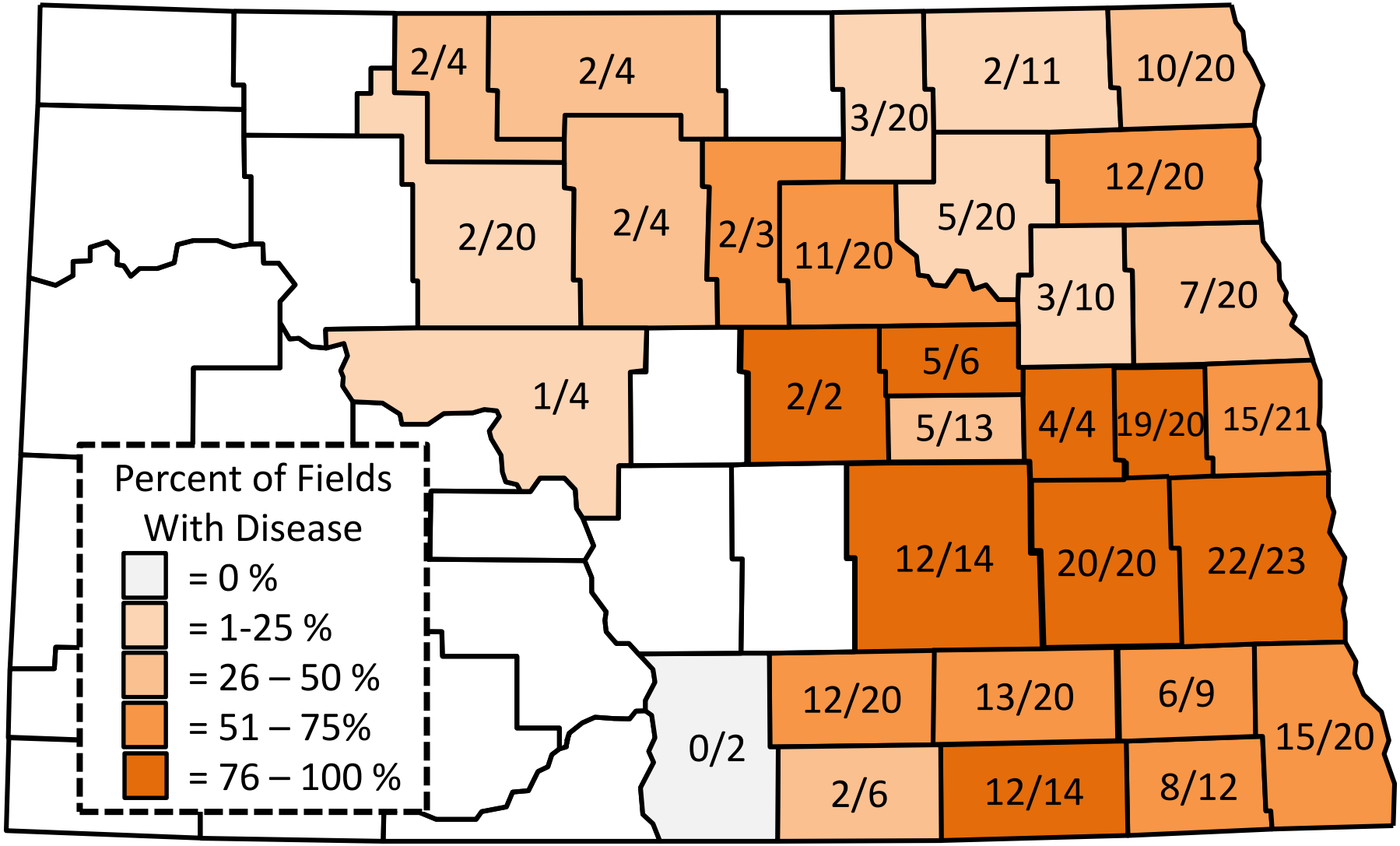

Phomopsis seed decay

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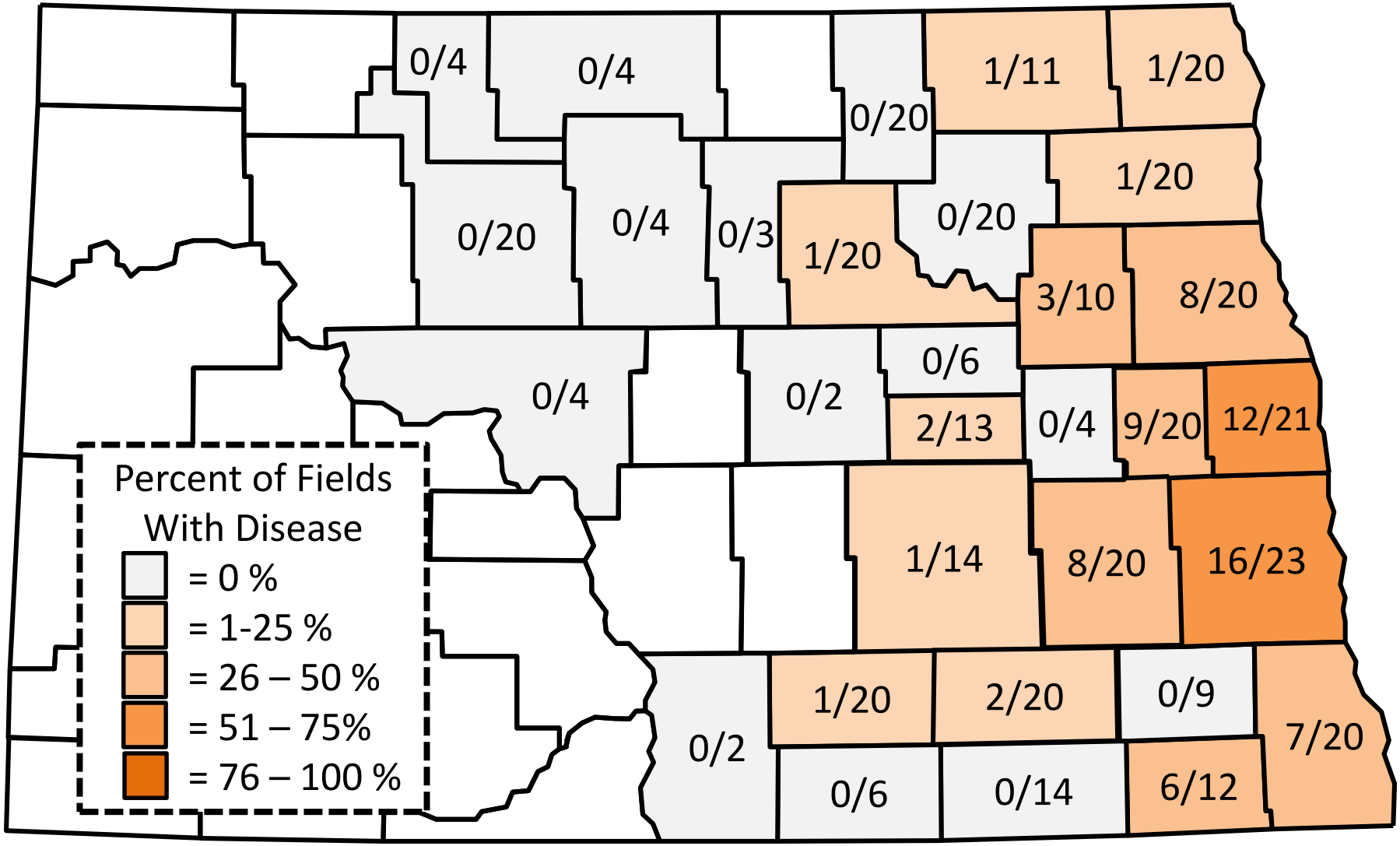

Charcoal rot

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Charcoal Rot

- Pathogen
  - Fungal, Soil borne, survives as microsclerotia
- Host Range
  - Soybean, Corn, Sunflower, legumes +
- Favorable Conditions
  - Hot temperatures
  - Drought stress
  - SCN present


Photo: Berlin Nelson

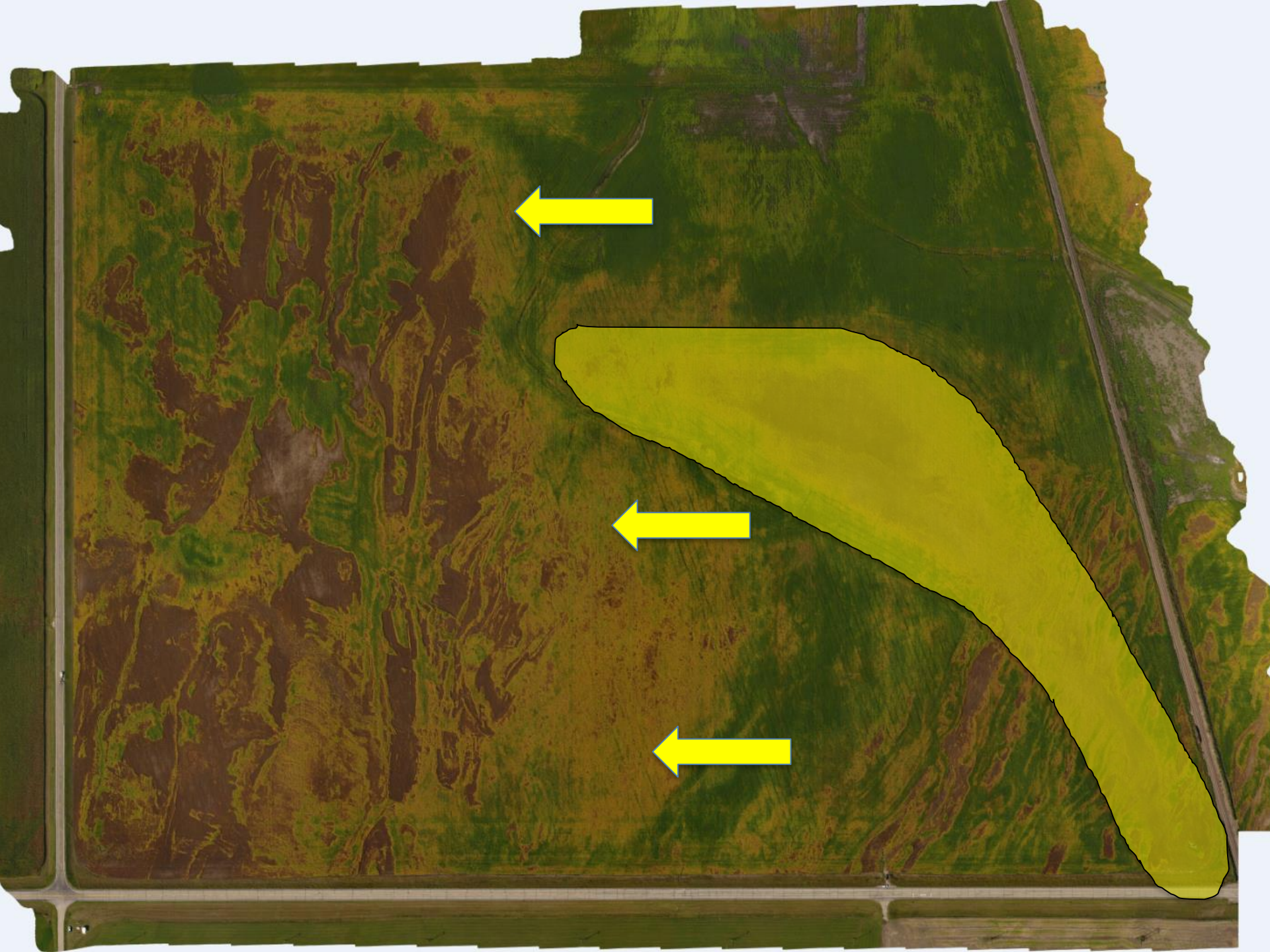


Photo: Berlin Nelson

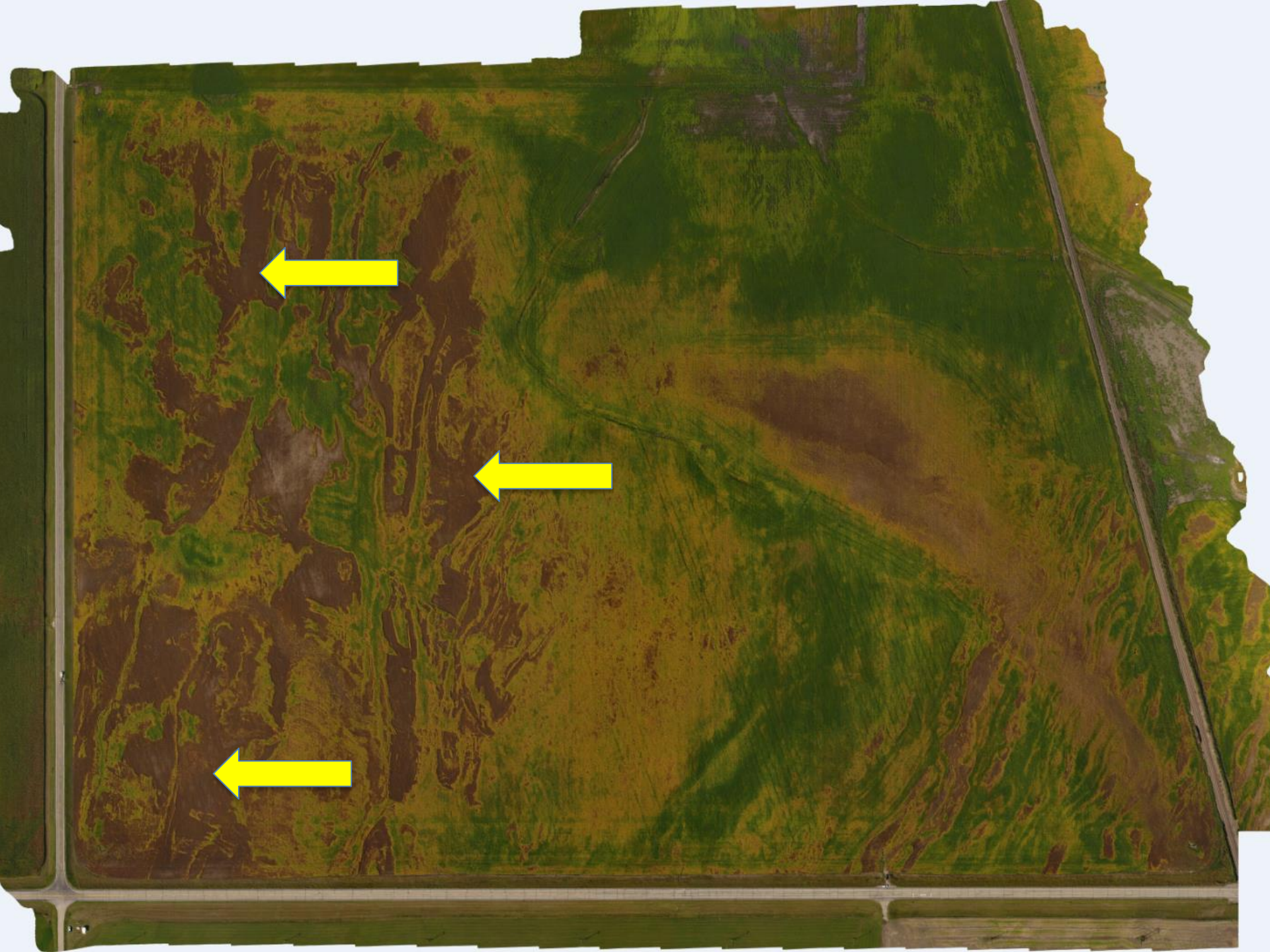


Photo: Berlin Nelson

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Charcoal rot

Macrophomina phaseolina (fungus)

Figure 1

Photo: B. Nelson, NDSU

Figure 2

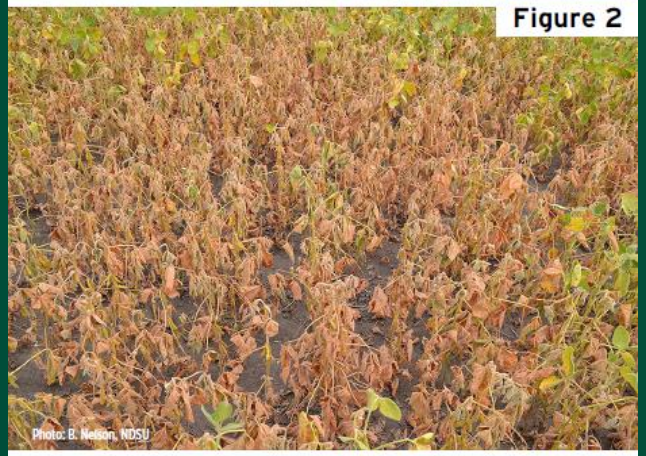

Photo: B. Nelson, NDSU

Figure 3

Photo: B. Nelson, NDSU

Figure 4

Photo: S. Markell, NDSU

PP1867-10
Soybean Disease Diagnostic Series

Charcoal rot

Macrophomina phaseolina (fungus)

AUTHORS: Sam Markell and Dean Malvick

SYMPTOMS

- Symptoms usually not apparent until flowering or later
- Taproot and lower stem may appear gray/silver
- Numerous black fungal specks (microsclerotia) under epidermis give a "charcoal" appearance
- Premature death with wilted leaves attached
- Frequently occurs in patches in fields

FIGURE 1 - Large patches of soybean with charcoal rot

FIGURE 2 - Patch of wilting soybeans

FIGURE 3 - Infected (L and C) and healthy soybean (R)

FIGURE 4 - External gray lesion peeling away, revealing profuse "charcoal' sclerotia

FACTORS FAVORING DEVELOPMENT

- Hot temperatures
- Drought stress
- May be more severe when soybean cyst nematode is present

IMPORTANT FACTS

- Yield loss may occur in hot, dry growing seasons
- Disease typically most severe in drought-prone areas of fields
- Very wide host range, which includes corn, sunflower, other legume crops and weeds
- Commonly confused with anthracnose, Phytophthora stem rot, pod and stem blight, stem canker

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Figure 3

Photo: B. Nelson, NDSU

Figure 4

Photo: S. Markell, NDSU

Brown Stem Rot

- Pathogen
  - *Cadophora gergata (Phialophora gregata)*
- Host Range
  - Soybean
- Favorable conditions
  - Limited rotation, wet and cool summer, SCN, susc varieties
- Distribution
  - Present, how common?
  - Two genotypes A and B

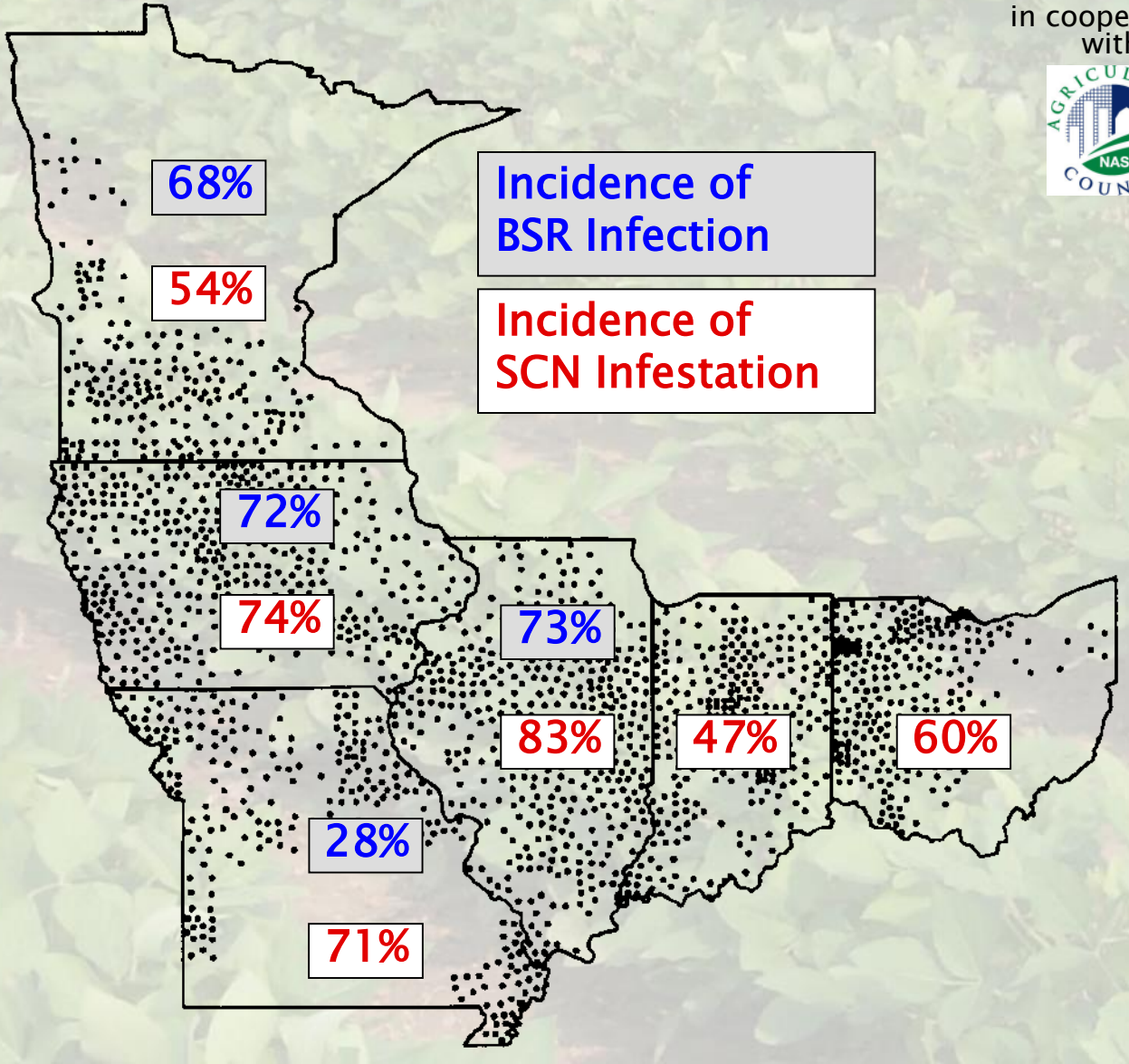

Soybean Cyst Nematode + Brown Stem Rot
Kandel, NDSU

D. Malvick U of MN

Brown Stem Rot

Random Survey Sample Sites, 1995 – 1996

in cooperation with

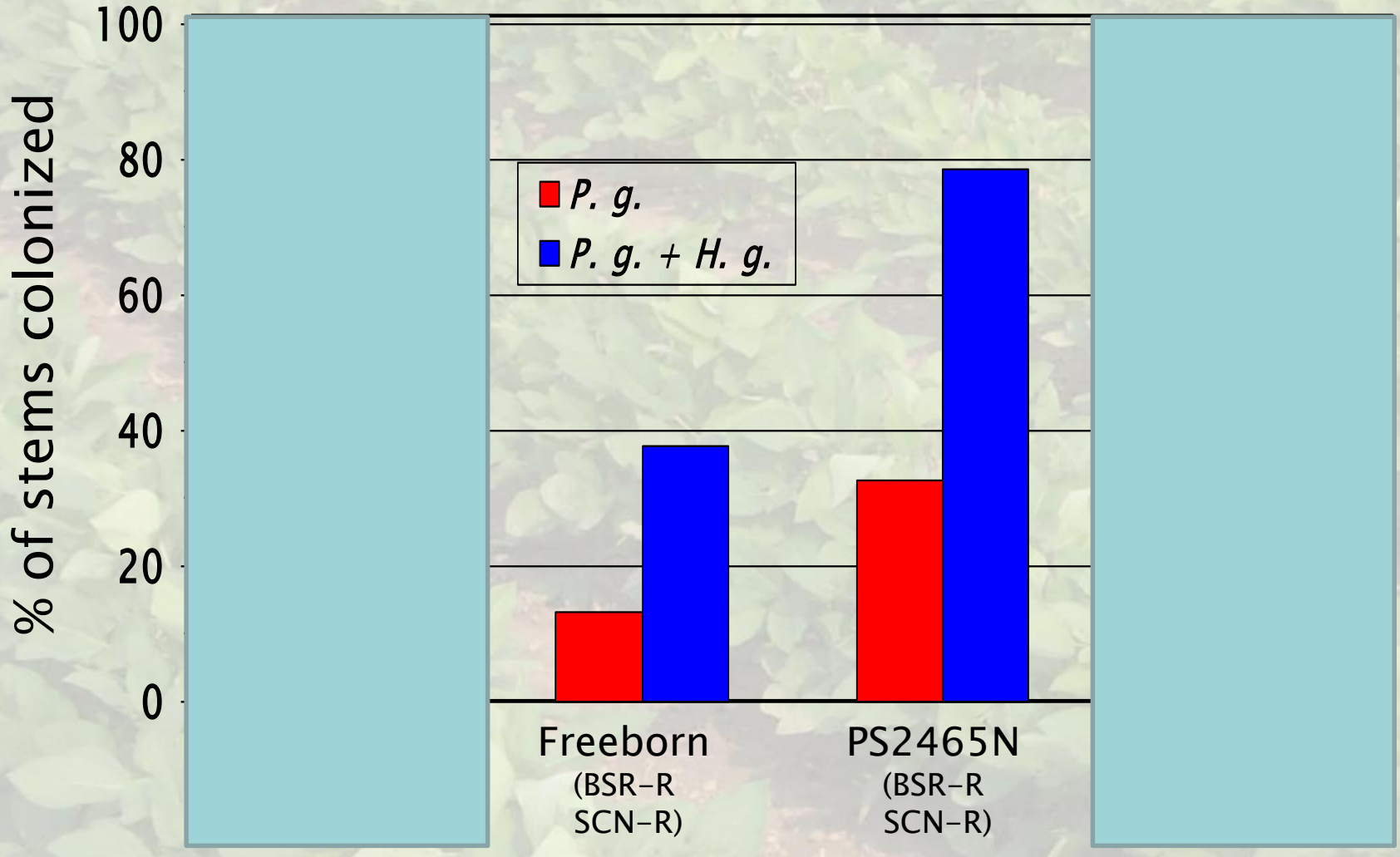


Courtesy, Greg Tylka ISU

Colonization of 4 soybean varieties by *P. gregata*

70 days after inoculation

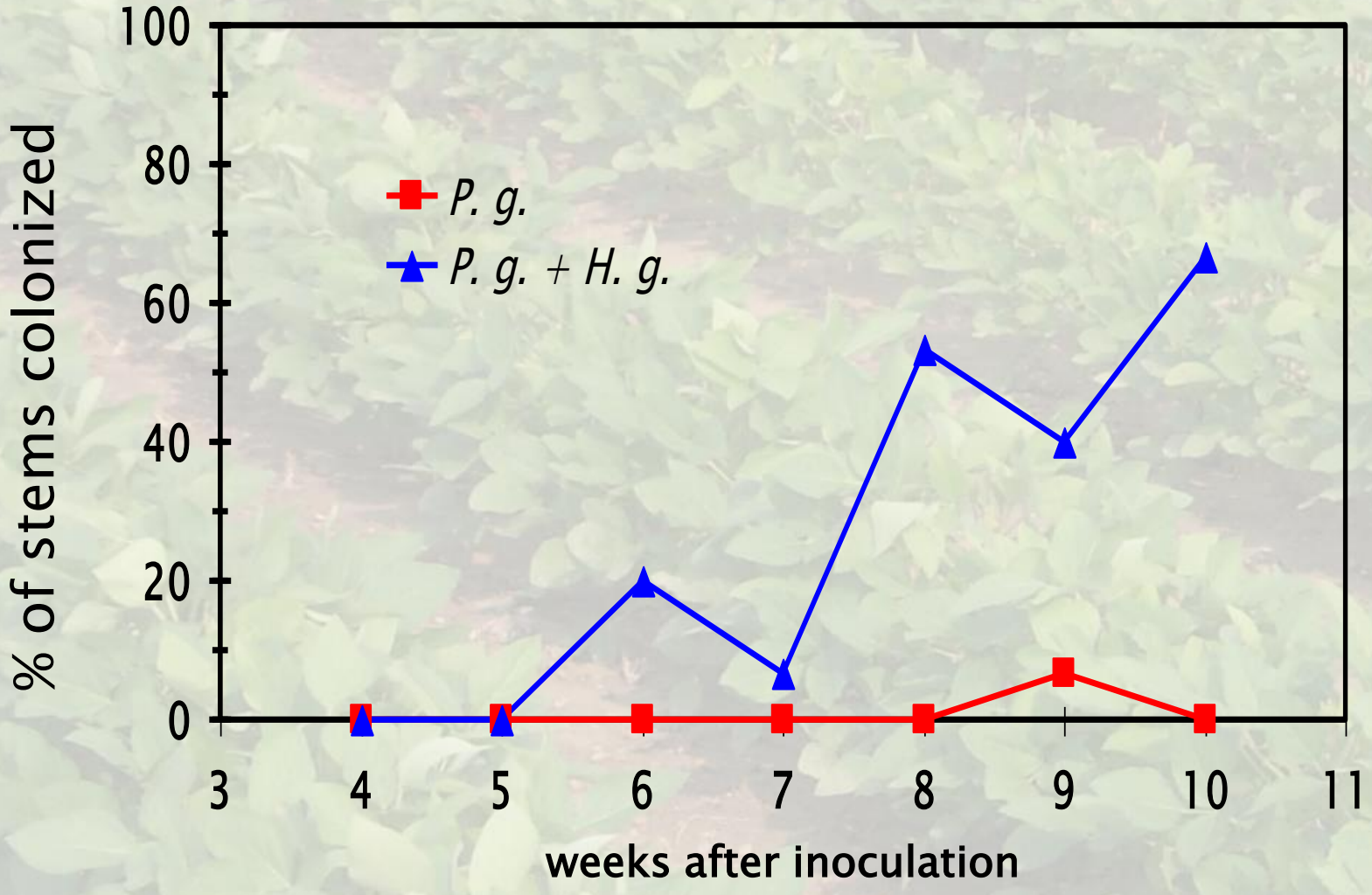
Presence of SCN increases BSR colonization



Courtesy, Greg Tylka ISU

Colonization of BSR101 by *P. gregata*

same trend for susceptible soybean variety



Sudden Death Syndrome

- *Fusarium virguliforme*
- Confirmed in Richland Co. / Ottertail Co.
- Linked to SCN
  - Onset of symptoms, severity, survival/spread, SCN resistance may help.

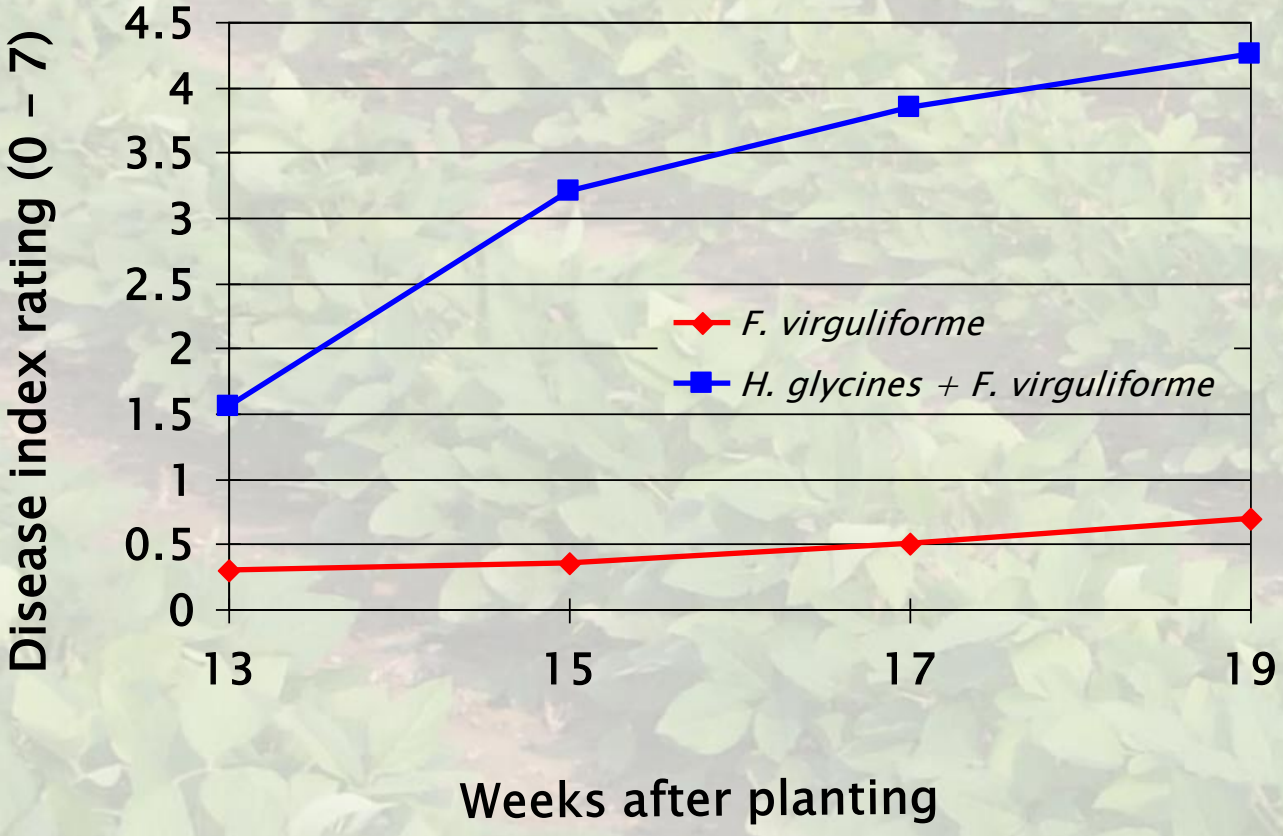
Nelson

Sam Markell


Berlin Nelson

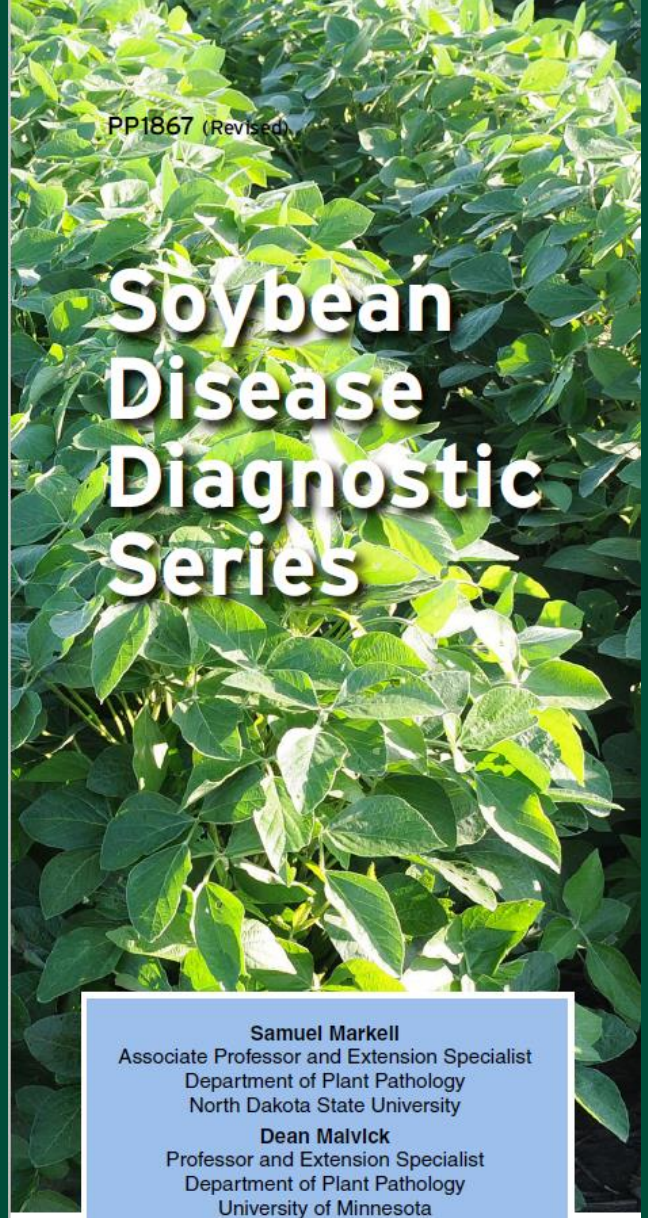
Berlin Nelson

SCN hastens onset and increases severity of SDS foliar symptoms



McLean & Lawrence, 1993, Journal of Nematology 25:434–439.

Courtesy, Greg Tylka ISU



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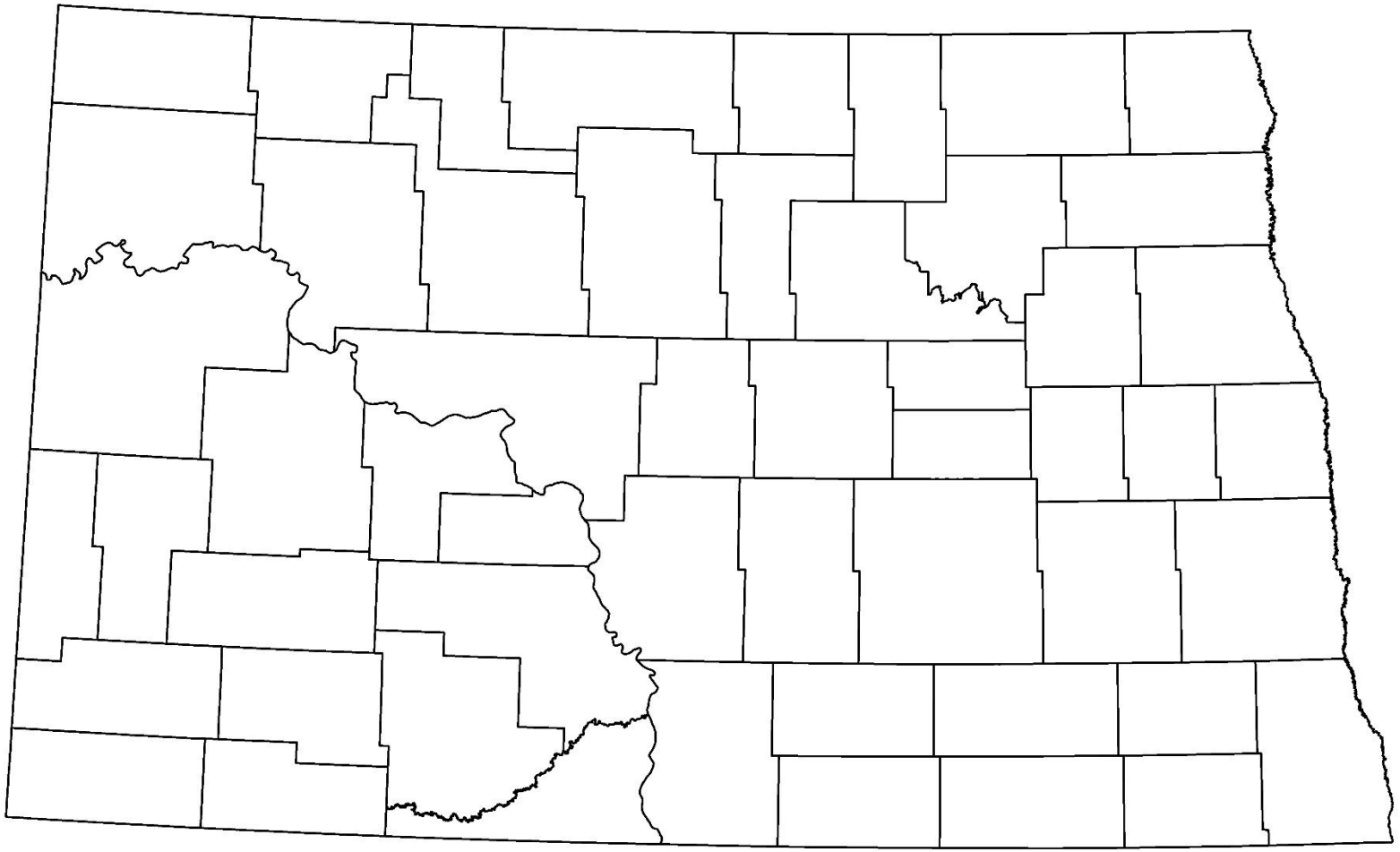
Root Diseases

Stem Diseases

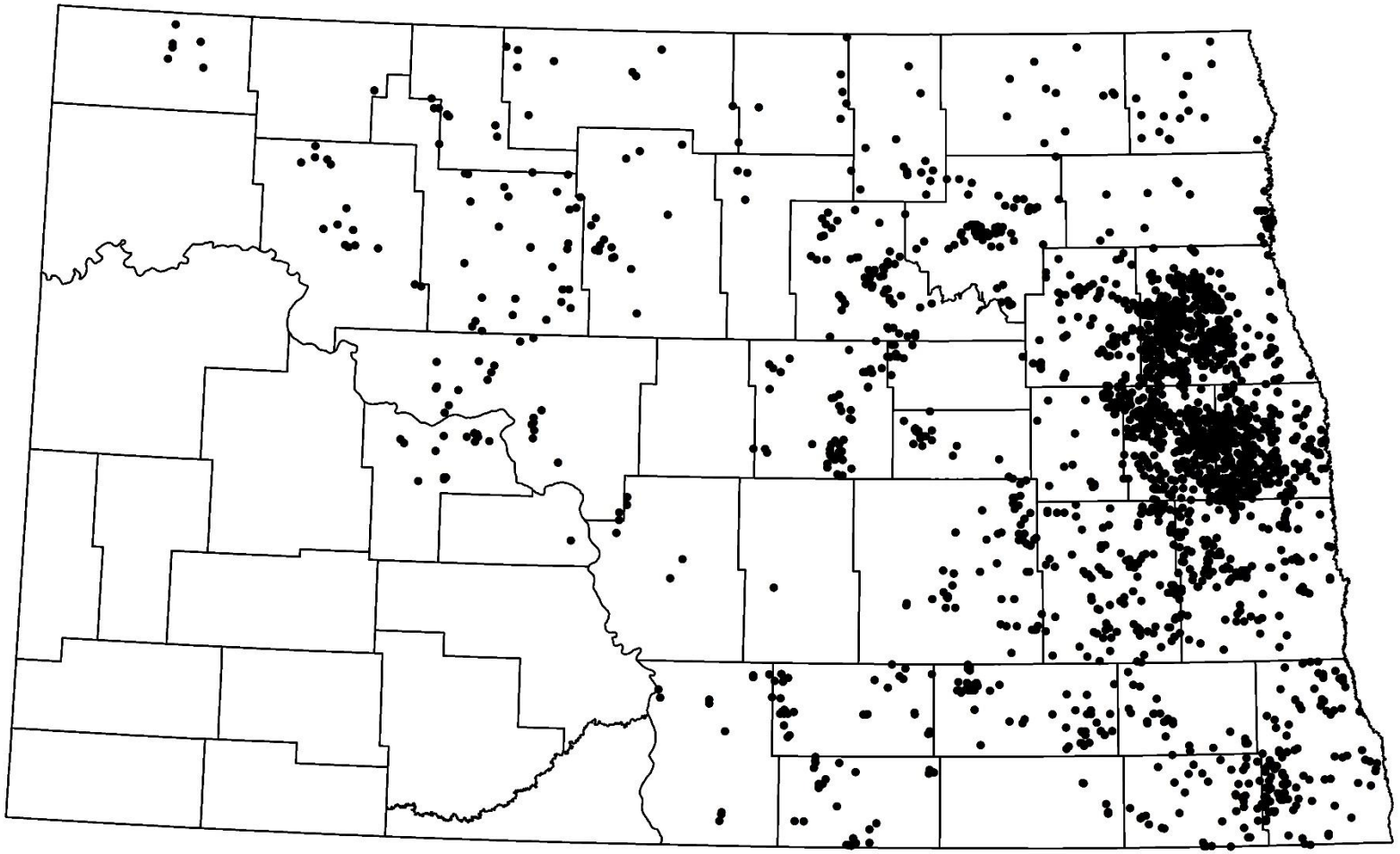
Leaf Diseases

Photo: Sam Markell

SCN Survey 2013-2019



SCN Survey 2013-2019



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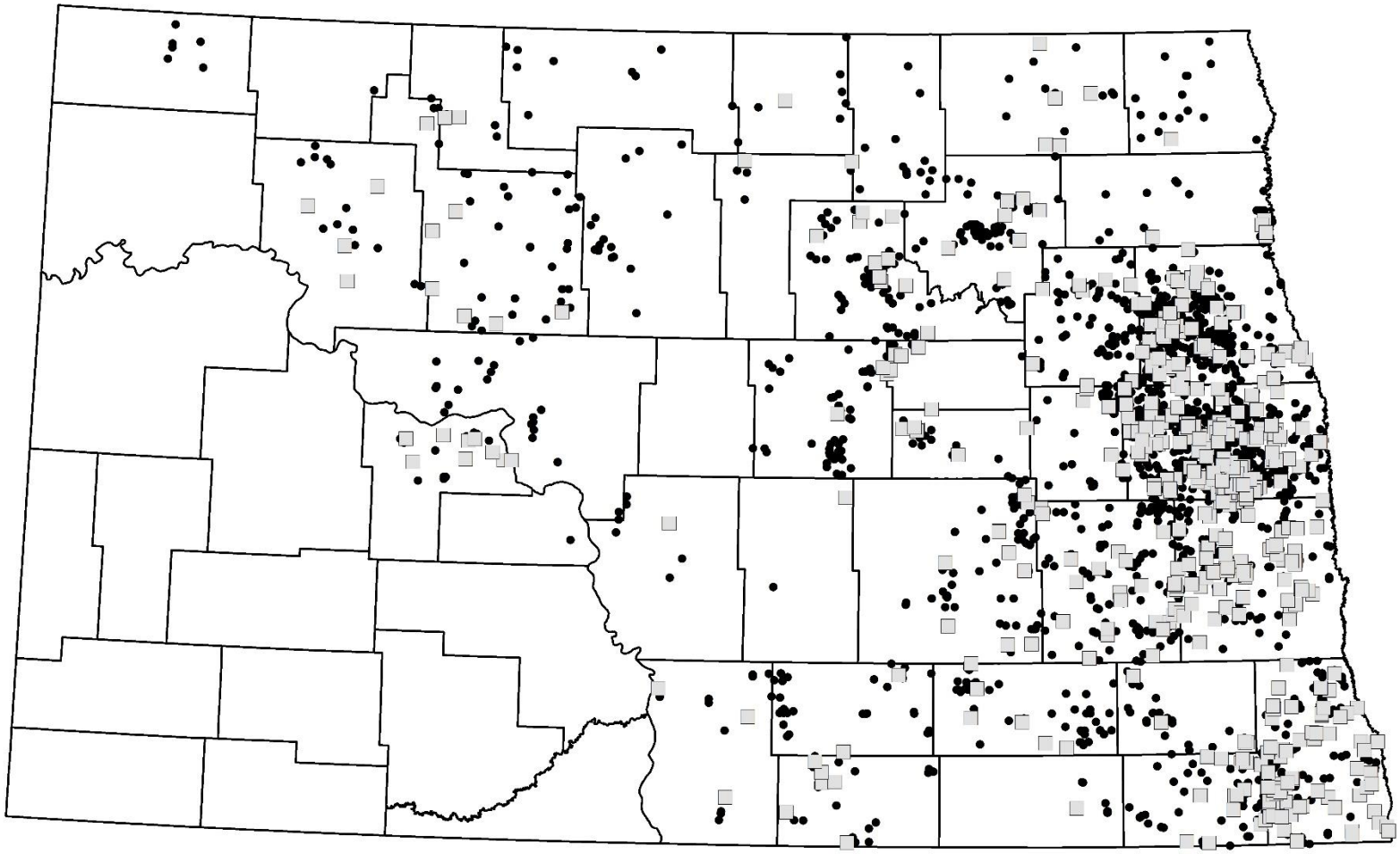
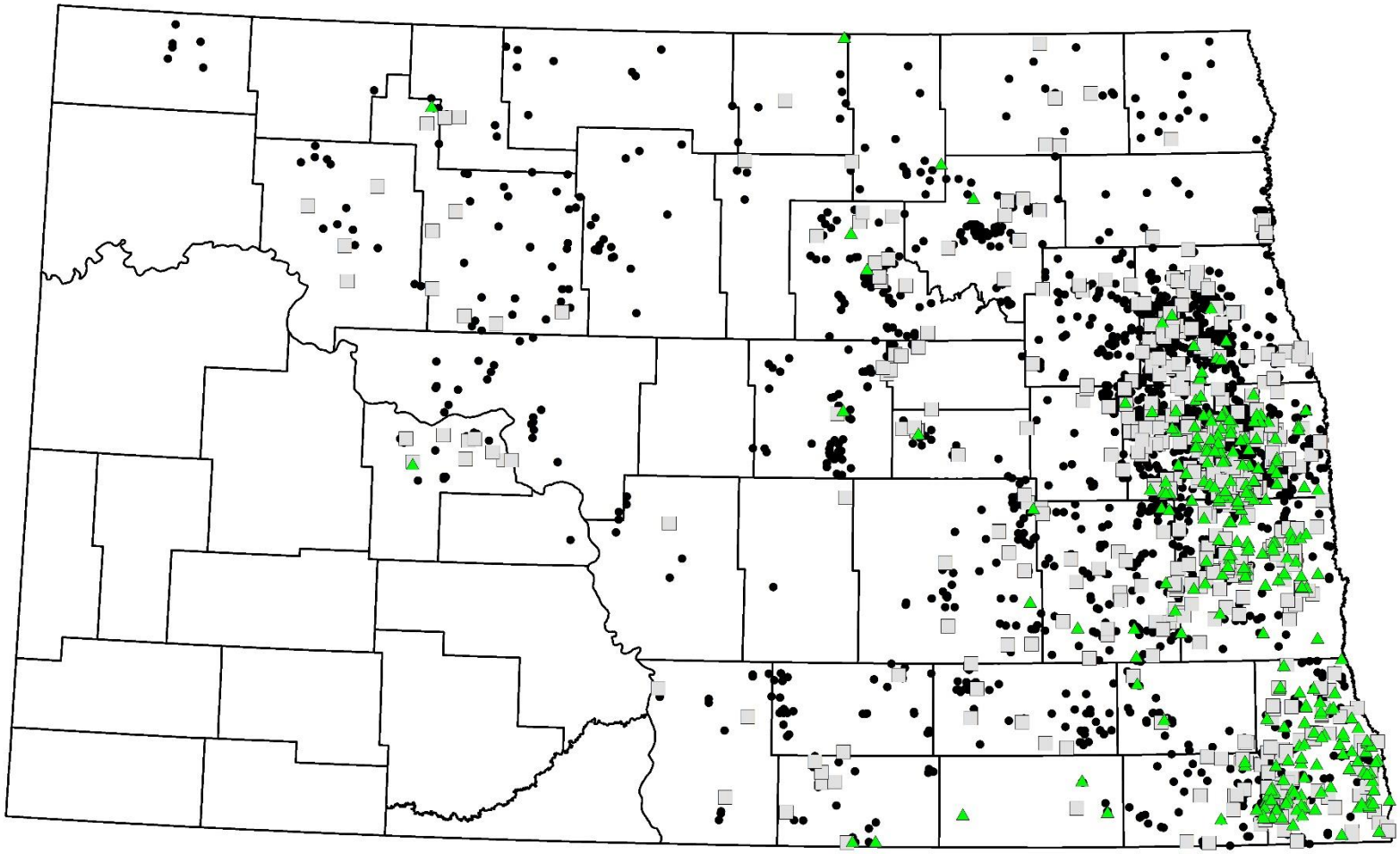
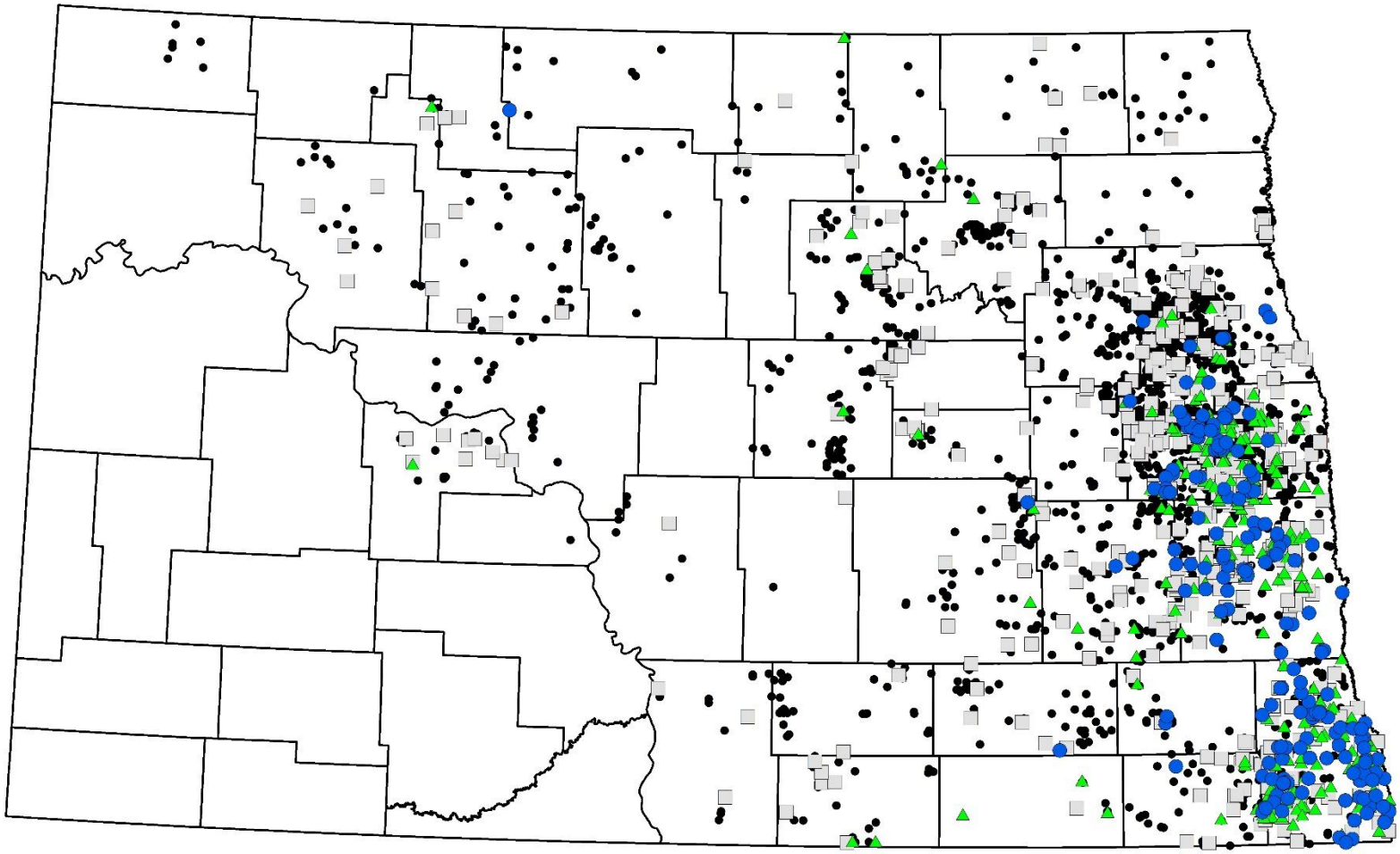


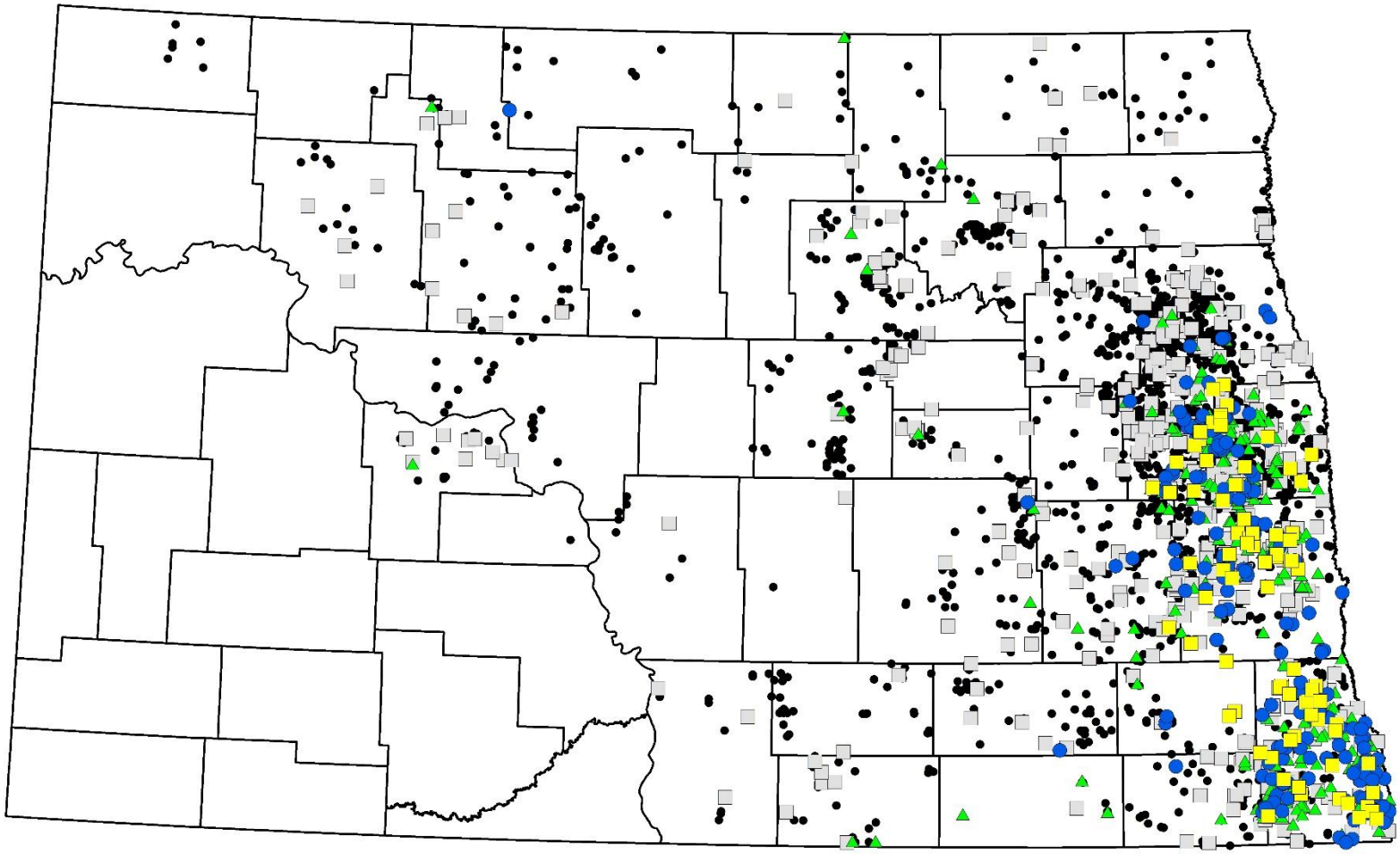
SCN Survey 2013-2019



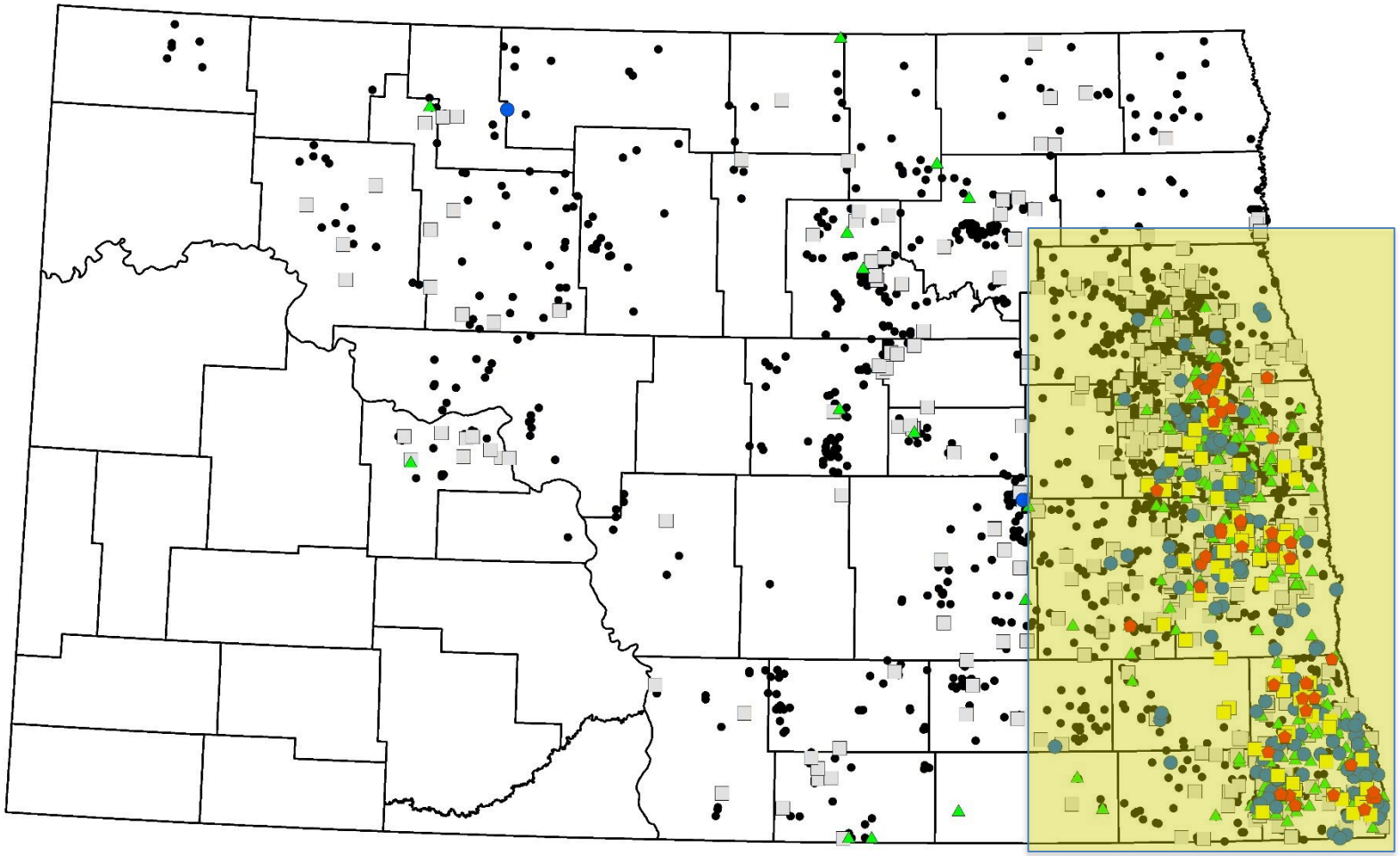
SCN Survey 2013-2019

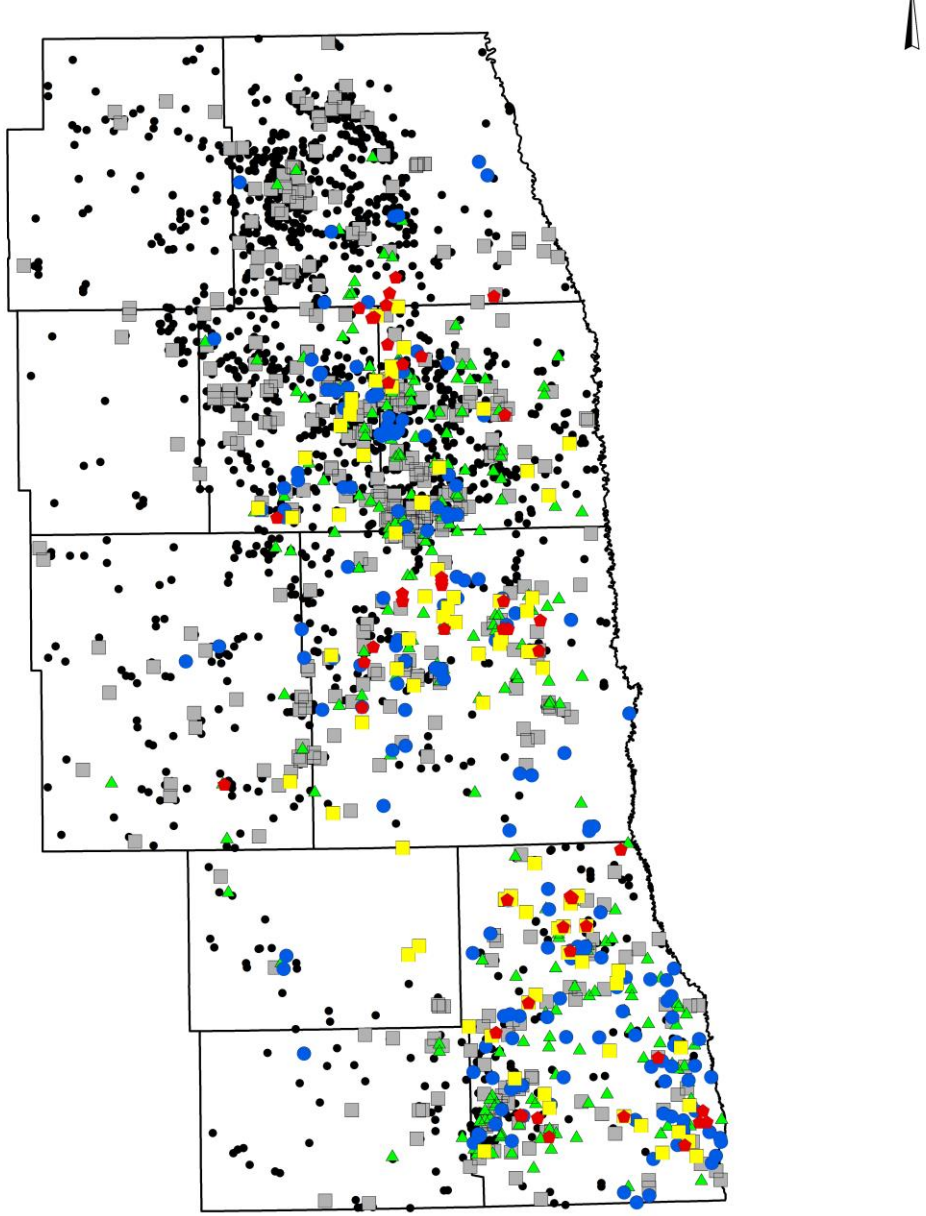


SCN Survey 2013-2019



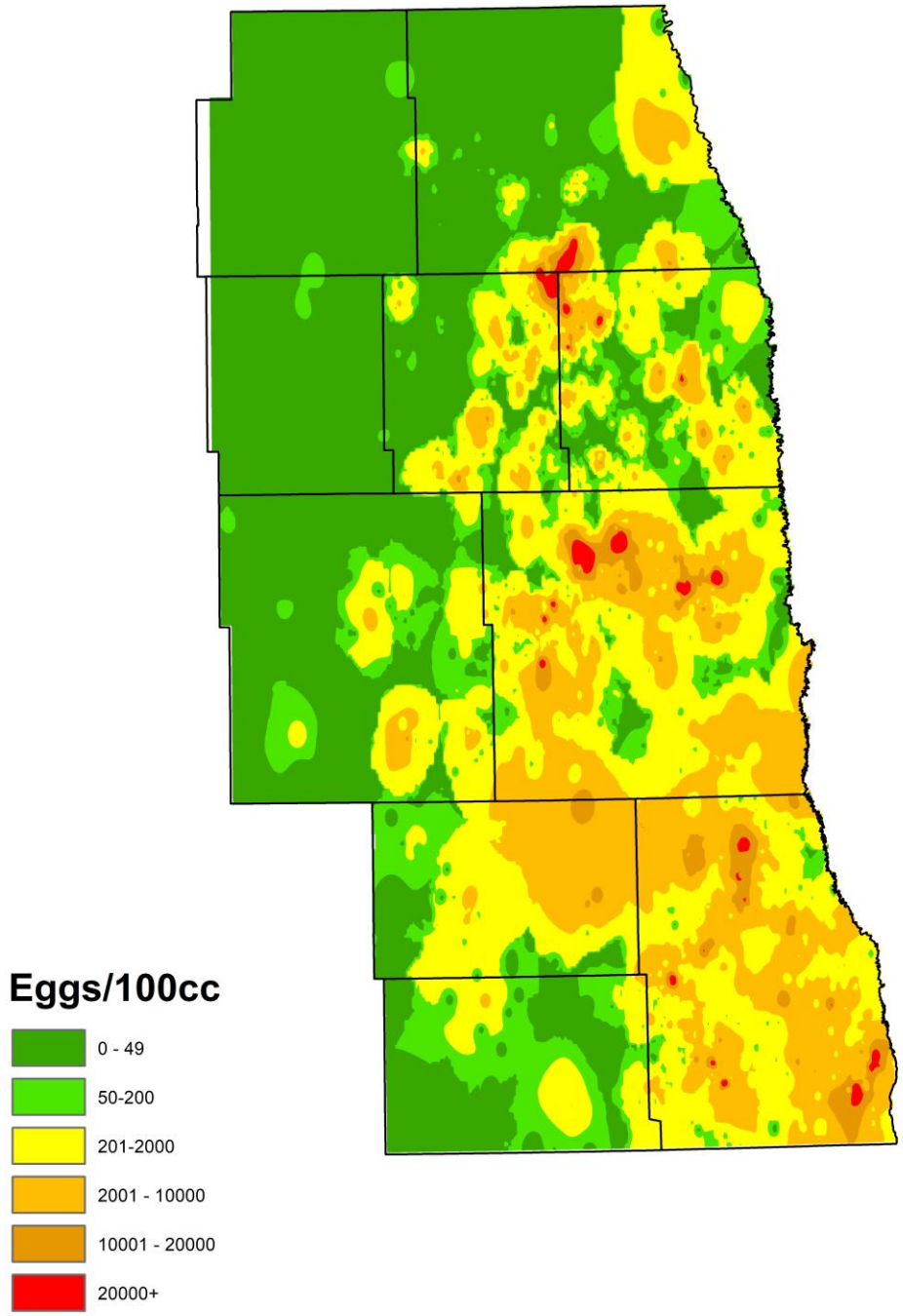
SCN Survey 2013-2019





Eggs/100cc

0 - 49 | 50 - 200 | 201 - 2000 | 2001 - 10000 | 10001 - 20000 | 20000+


Eggs/100cc
0 - 49
50-200
201-2000
2001 - 10000
10001 - 20000
20000+

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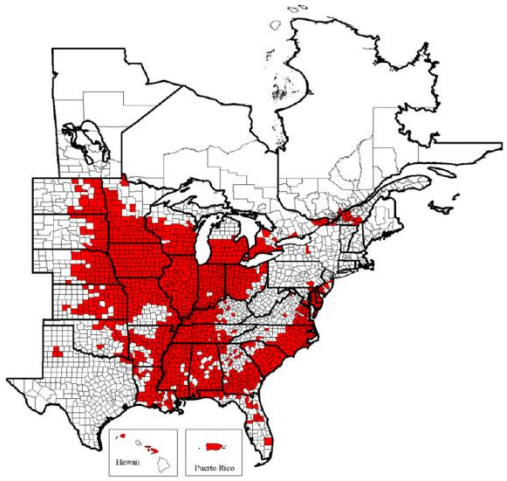

FIGURE 1
Map of the known distribution of the soybean cyst nematode, *Heterodera glycines*, in the United States and Canada from 1954 to 2017. Known infested counties are indicated in red. Map © C. C. Marett and G. L. Tylka, Iowa State University, 2017.


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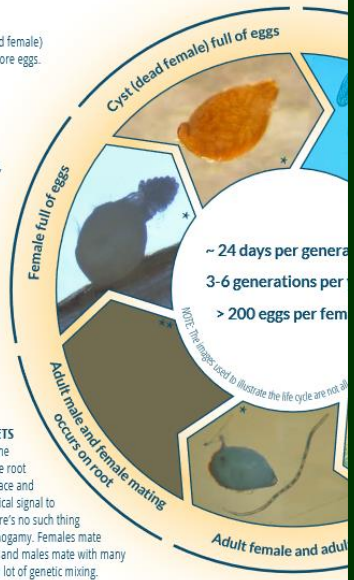
WHY YOU NEED TO TEST YOUR FIELDS TO KNOW YOUR NUMB

THE SOYBEAN CYST NEMATODE life cycle.

The S
during
gener

EACH CYST (dead female) contains 200 or more eggs.



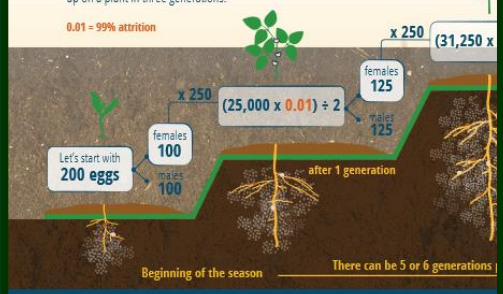
AFTER MATING, she makes about 50 eggs outside her body and fills up with another 200+ internally. Then she dies and her body wall hardens to form the cyst.

THE FEMALE GETS SO LARGE that she ruptures out of the root onto the root surface and sends out a chemical signal to attract mates. There's no such thing as nematode monogamy. Females mate with many males, and males mate with many females. There's a lot of genetic mixing.

IF THE JUVENILE IS MALE, back to a worm shape and leav

WHY YOU NEED TO TEST YOUR FIELDS to know your numbers.

Even with an attrition rate of 99% – meaning only 1% of eggs survive each generation – this is how quickly SCN egg populations can build up on a plant in three generations.



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HOW THE SCN PROBLEM EVOLVED

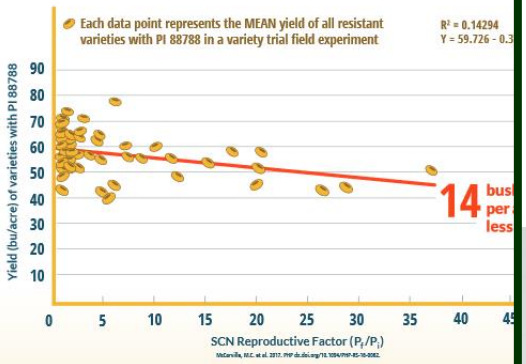
TOO MUCH of a good thing.

For more than 20 years, greater than 95 percent of all SCN-resistant soybean varieties have included resistance from the PI 88788 breeding line.

Nematodes are becoming "resistant to the resistance."

A resistant variety should allow less than 10 percent reproduction. In other words, a resistant variety should stop 90 percent of the SCN in a field from reproducing. Across the region, varieties with PI 88788 resistance aren't hitting the mark. On some farms, one out of every two nematodes can reproduce.

AS SCN REPRODUCTION INCREASES, yields decrease by as much as 14 bushels per acre.



NEW SCN MANAGEMENT recommendations.

Work with your advisors and develop a plan to manage SCN:

- Test your fields to know your numbers.
- Rotate resistant varieties.*
- Rotate to non-host crops.
- Consider using a nematode-protectant seed treatment.

** SCN populations can adapt to individual resistant varieties as well as to sources of resistan So, rotating to a different resistant variety — even if it's still PI 88788 — may help slow the*

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SCOUTING AND SOIL TESTING FOR SOYBEAN CYST NEMATODE.

What's your number?
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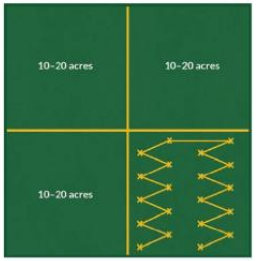
TWO WAYS to scout for SCN.

1 Dig roots and look for females. (Dig, don't pull.)

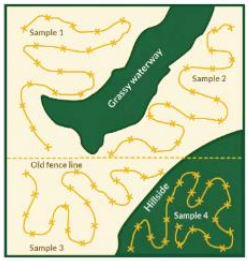
2 Collect soil samples for testing.

THREE APPROACHES to collecting soil samples.

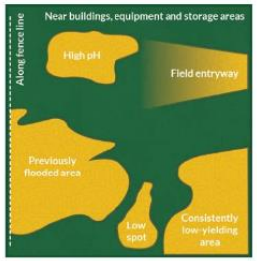
Collect 15–20 (or more) 1-inch-diameter core samples, 8 inches deep, for every 20 acres. Mix the cores well, put the mixed soil into a soil sample bag and send it to an SCN testing lab.



1 Collect soil cores using a zigzag pattern.



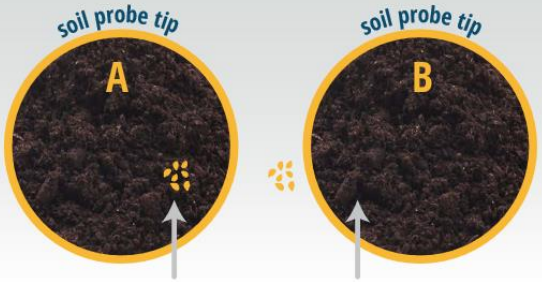
2 Collect soil cores from logical areas or management zones in the field.



3 Collect soil cores from high-risk areas in the field where SCN might first be discovered.

WHY SCN SOIL TEST results are variable.

It all depends on where you put the probe. A ½-inch difference can mean the difference between zero and 1,500 eggs. (Each cyst can hold 200 to 250 eggs.)



7 SCN cysts
egg count = 1,500

0 SCN cysts
egg count = 0

WHEN to sample.

- Fall in a non-host crop.
- Fall in soybean stubble.
- Spring before a soybean crop.
- During the season in the soybean crop root zone.

Visit *TheSCNcoalition.com* for more information.